

Grant: AFC518-16

Title: Development of Direct Sensing Sampler for Submicron Mining Particles Including Coal, Silica and Nano-Sized Diesel Particulates

Organization: Colorado State University

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Topic: Health-related Monitoring Devices

Concept Summary: Sub micrometer and nanometer-sized particles represent a potentially serious but largely unstudied exposure in the mining environment. Workers in the mining environment might be exposed to significant amounts of nanometer-sized particles from coal dust, silica particles and diesel exhaust but currently available respirable sampling methods are unable to quantify this exposure. The goal of this project is to meet the performance requirements of a personal sampler that can measure the nanometer and sub micrometer portion of the respirable particles. Samplers will be designed to collect particles with two different cut diameters within the respirable size range without using a cyclone as a pre-separator, and a direct reading capacitive sensor will be designed to measure the deposited particles in real time. These new features are not available from currently used samplers and direct-reading instruments.

The capacitive sensor strip attached to the filter in the sampler will provide real-time monitoring of total particle concentration dose within the range of particles sizes selected by inlet nozzle design and air flow of the sampler. The proposed sensing approach relies on a shift in capacitance due to the dielectric loading of particles deposited on the interdigitated capacitor structure. A grid attached filter is used to collect particles from nanometer to micrometer sizes; deposited particles can then be analyzed using both real time measurement and off line analysis. Particle size distribution can be determined from off line microscope and image analysis. Particle size, particle quantity and environmental humidity are considered in the design. The sampler will be rugged enough to operate in the underground mine environment and simple for the worker to wear and use. Informative technical results will be produced to demonstrate the feasibility of this design approach.